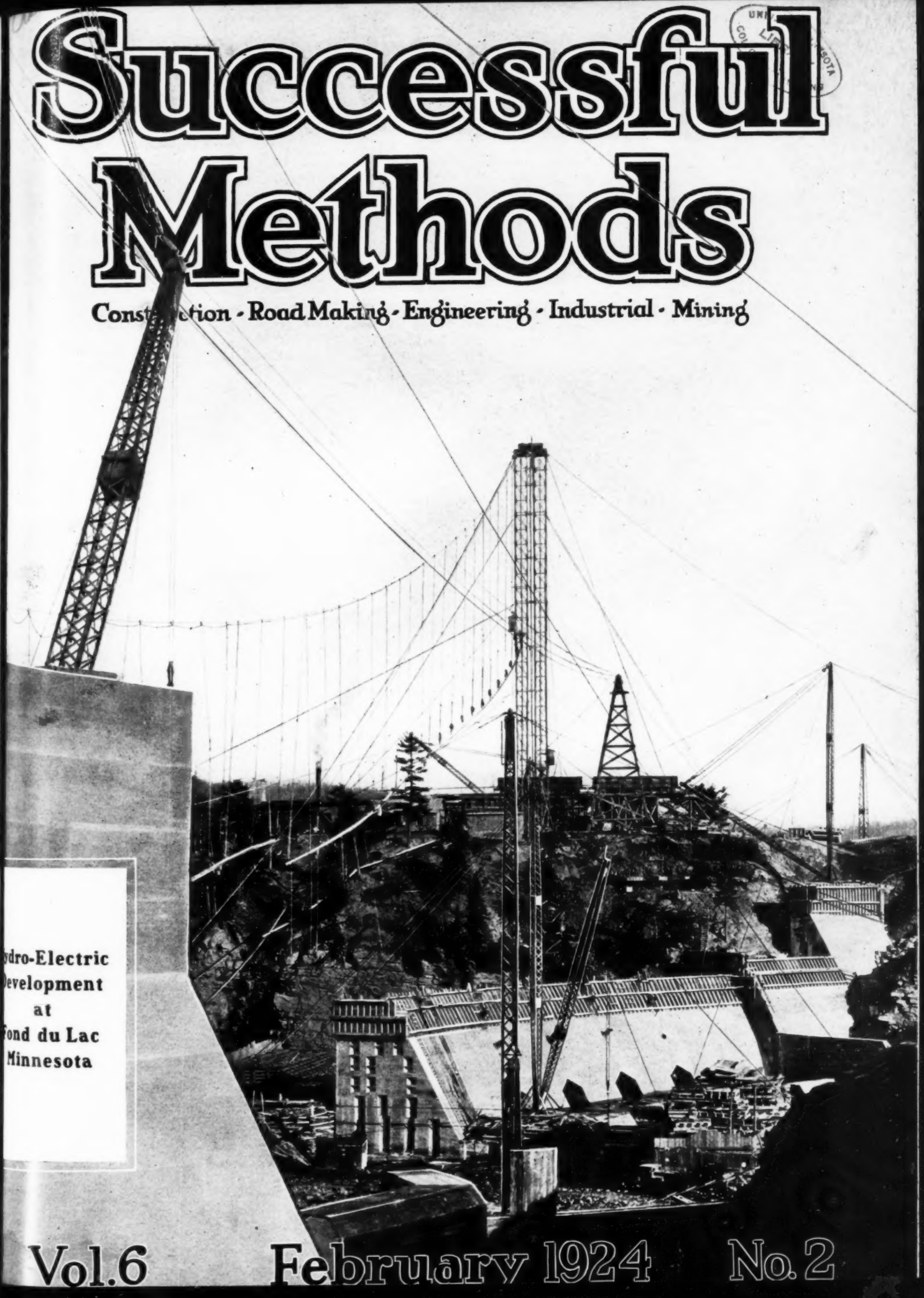
Successful Methods

Construction - Road Making - Engineering - Industrial - Mining

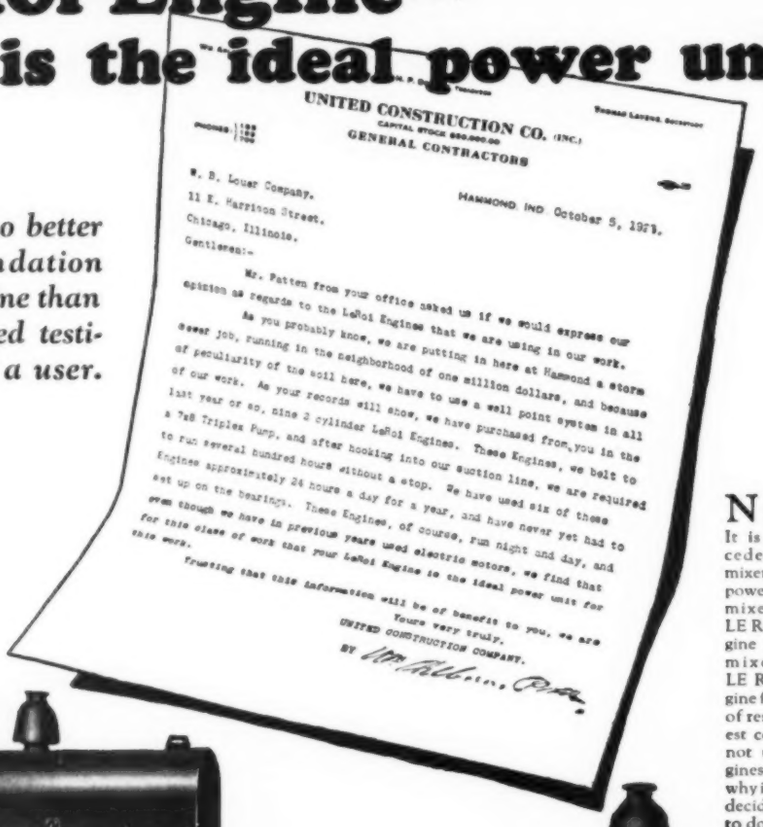


ydro-Electric
evelopment
at
ond du Lac
Minnesota

Vol. 6 February 1924 No. 2

"LE ROI Engine—
is the ideal power unit"

There is no better recommendation for an engine than the unbiased testimonial of a user.



UNITED CONSTRUCTION CO. (INC.)
CAPITAL STOCK $50,000.00
GENERAL CONTRACTORS

W. B. Louer Company.
11 E. Harrison Street.
Chicago, Illinois.

HAMMOND, IND. October 5, 1921.

Gentlemen:-

Mr. Patten from your office asked us if we would express our opinion as regards to the LeRoi Engines that we are using in our work.

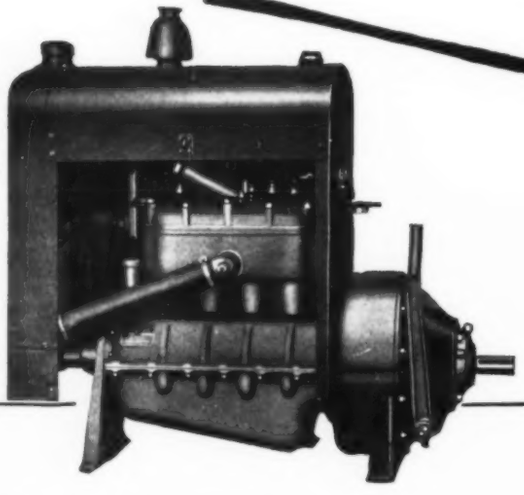
As you probably know, we are putting in here at Hammond a storm sewer job, running in the neighborhood of one million dollars, and because of peculiarity of the soil here, we have to use a well point system in all of our work. As your records will show, we have purchased from you in the last year or so, nine 2 cylinder LeRoi Engines. These Engines, we belt to a 7x8 Triplex Pump, and after hooking into our suction line, we are required to run several hundred hours without a stop. We have used six of these Engines approximately 24 hours a day for a year, and have never yet had to set up on the bearings. These Engines, of course, run night and day, and even though we have in previous years used electric motors, we find that for this class of work that your LeRoi Engine is the ideal power unit for this work.

Trusting that this information will be of benefit to you, we are

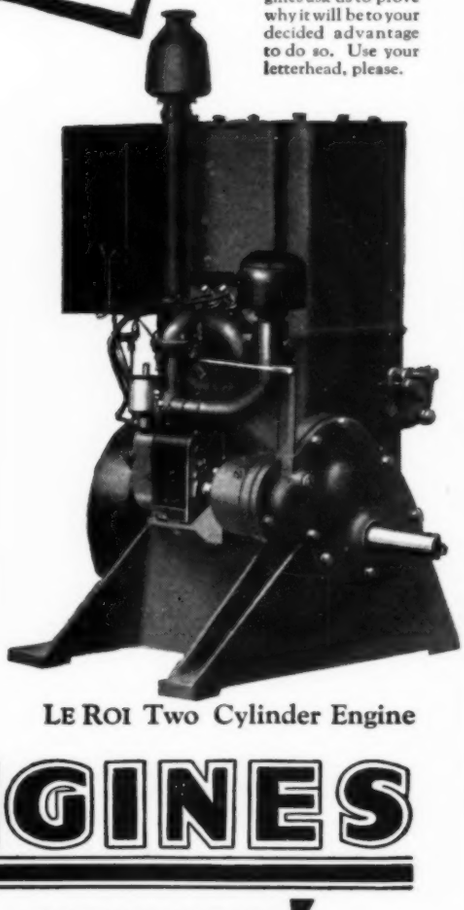
Yours very truly,
UNITED CONSTRUCTION COMPANY.
BY

NOTE

It is generally conceded that most mixers are underpowered. Every 4S mixer requires a LE ROI 4 H. P. Engine and every 7S mixer requires a LE ROI 8 H. P. Engine for a maximum of results at the lowest cost. If you are not using these engines ask us to prove why it will be to your decided advantage to do so. Use your letterhead, please.



LE ROI 4 Cylinder Engine



LE ROI Two Cylinder Engine

LE ROI Power Service

HOPPER COOLED TYPE—3 to 4 H. P. Single Cylinder—5 to 8 H. P. Two Cylinder.

RADIATOR COOLED TYPE—5 to 8 H. P. Two Cylinder—10 to 15 H. P. Four Cylinder.

LE ROI COMPANY, *Milwaukee, U.S.A.*

LE ROI ENGINES

for dependable power!

Successful Methods

A Magazine of Construction Service

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Seriously Successful

THE annual convention and road show of the American Road Builders' Association were both successful. Big words and loud talk are unnecessary in describing them. Under careful, conservative management these two great events have been placed on a stable basis worthy of the vast industry which makes them desirable.

Upwards of 20,000 engineers, contractors and producers went to Chicago to attend the convention and to visit the road show. The sessions of the convention were crowded with men who heard excellent programs. The road show literally was jammed with exhibits and buyers. This show has become one of the world's great industrial fairs.

Truly it may be said that the convention and road show of the American Road Builders' Association are embarrassed by success. They have attained a momentum that is serious. The proper direction of them in the future involves a great responsibility.

Faster and More Reliable

PRESENT-DAY construction methods call for machinery which can stand the gaff. Not so long ago most construction machinery was in about the same class as farm machinery—built to sell at a price. Equipment of quality was decidedly the exception. User and maker generally agreed that the higher prices which go with good design, good materials and good workmanship were not justified by the conditions to be met. Then the war came along and changed the whole picture.

Prior to the war there was a tendency, it is true, toward the wider use of better construction equipment. The labor shortage during the war, and during the last two years, however, convinced all those who are alive enough to succeed permanently. They saw they were up against a new deal. No longer was it a case of a machine here and there on the job. In order to make any money, and often merely to get done at all, machines had to be used whenever they would save men. And these machines in turn became units of a plant, each more or less completely dependent on the ability of the rest to hold up their end without a let-up. What is more, the whole outfit had to produce at rates far above those that were formerly satisfactory.

Looking back now, it is easy to see what has happened. Users have condemned ruthlessly unsatisfactory details or a whole machine. These kicks usually were based on unreliability or on slowness of the machine criticized. The alert manufacturers have met the kicks by new models in which the weak spots were eliminated; or they have brought out entirely new types.

There has thus come about in a relatively short time an improvement in construction machinery that is as yet not generally realized. Less and less is price the deciding factor. Many builders of slow, flimsy machines keep in business, but their salesmen are hard put to convince the buyer that he can get speedy, reliable equipment on the basis of farm machinery prices.

There will always be low-priced construction equipment offered for sale, just as there will always be shoddy clothing and paper-soled shoes on the market. The day of the quality product in construction machinery is, however, here to stay. Both makers and users realize that low-priced equipment rarely is cheap, and that speed and reliability are worth all they cost.

Immigration

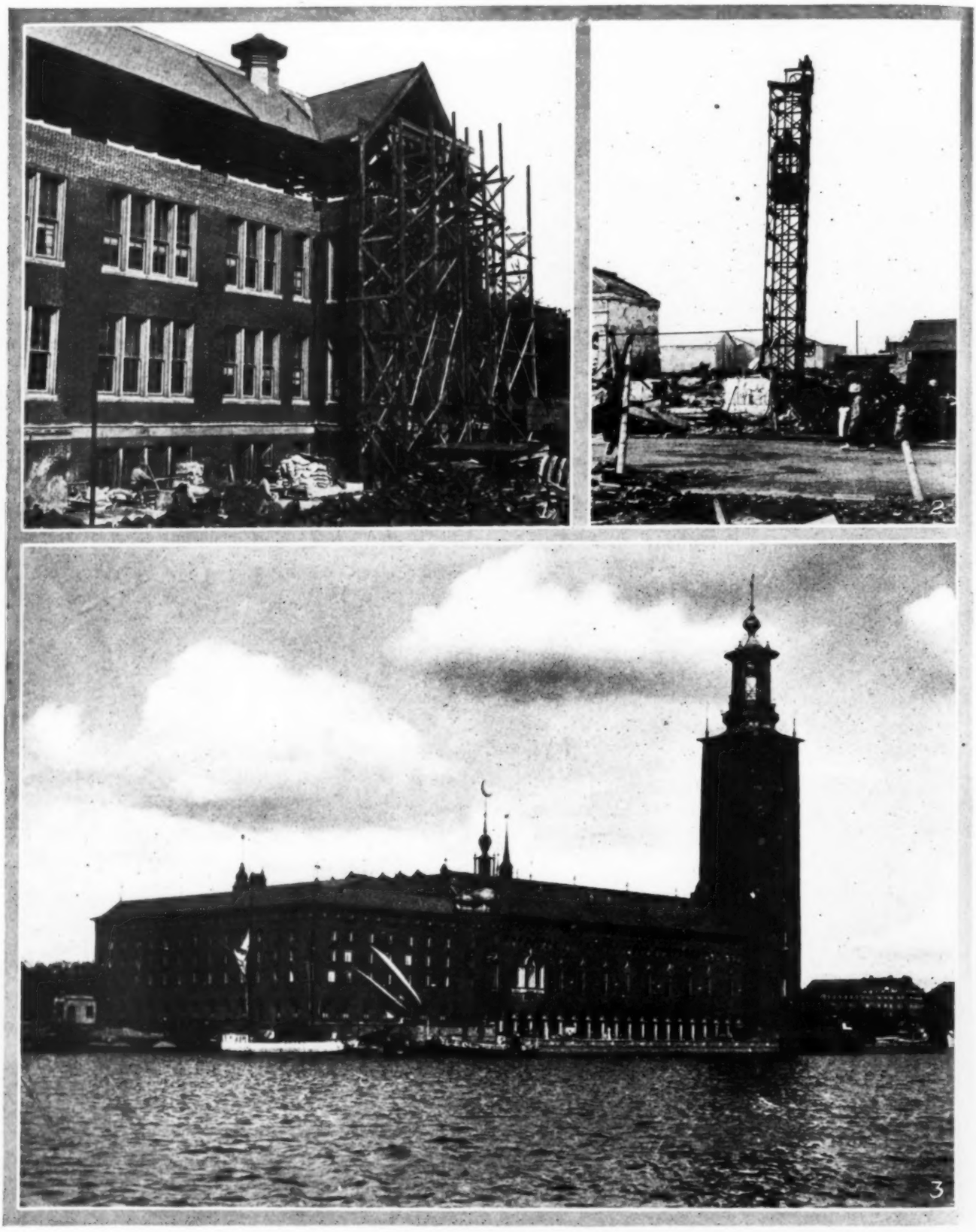
THE common labor shortage in the construction industry evidently is not to be relieved by any easing of the restrictions on immigation. On the contrary, every indication is that the number of foreigners admitted will shortly be further reduced. It also appears that the number let in from the countries which have lately supplied most of our common labor will be cut down more than any of the rest, except the Orient.

At the same time, there will evidently be this year a continuation of good business in most of the lines of industry in which common labor is largely used. This fact, coupled with no hope of relief from increased immigration, means that the construction industry must adjust its sights accordingly.

A wider use of labor-saving machinery would quickly take the edge off the situation. American constructors already use far more machinery to take the place of men than do the builders of any other nation. The amount of pick and shovel work, however, that could be done faster and cheaper with machines is still staggering. Many employers are slow to change their methods. This year bids fair to force them to change to machines or to fail.

Advise us if your copy of SUCCESSFUL METHODS does not reach you promptly after the first of each month. If you have changed your address send us your new location.

Types of Construction

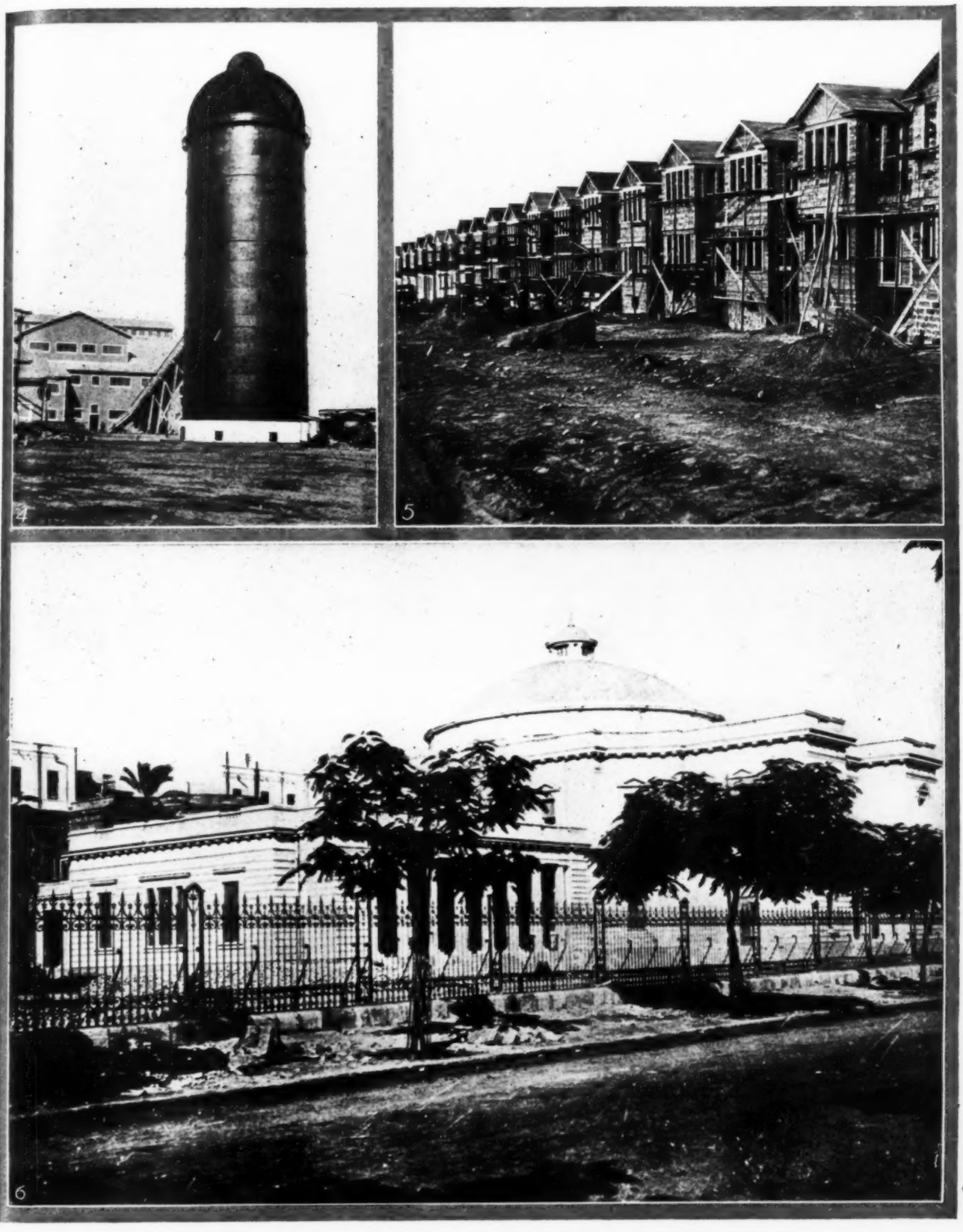


1—Enlarging a school at Washington, D. C., by the simple expedient of lifting the roof and putting in another story. © P & A Photos.

2—This American-built tower managed to withstand the Tokio earthquake, although it was jolted out of plumb. © P & A Photos.

3—The new Town Hall of Stockholm, Sweden. A remarka ble example of the new architecture that is now in vogue in Scandinavian countries. © P & A Photos.

From Four Continents



4—A mammoth incinerator said to be one of the largest in the world built recently at Fresno, Cal. © P & A Photos.

5—This row of houses in the suburbs of New York City was built by Wanda Winkel, a woman contractor. © Keystone Views.

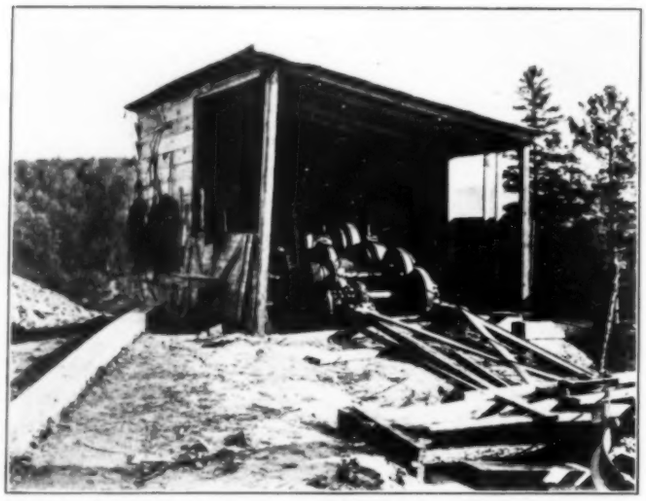
6—Egypt's new Parliament house at Cairo. This splendid building shows that the smaller nations are not lagging behind in construction work. © P & A Photos.

DERRICKS AND HOISTS FOR EVERY JOB

Well-Chosen Machines Speed Up Hydro-Electric Development on St. Louis River at Fond du Lac, Minn.

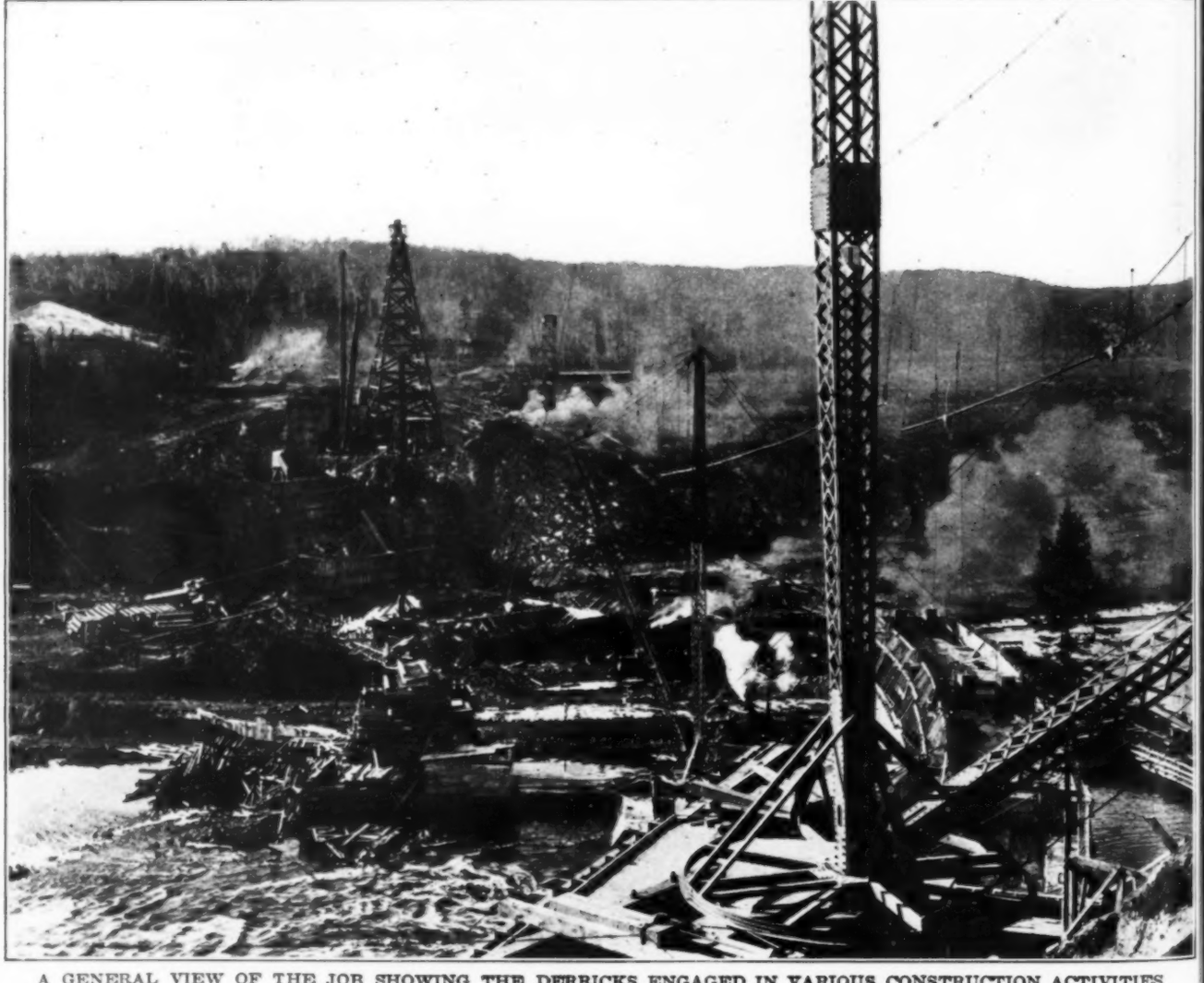
CONSTRUCTION work is progressing rapidly on the hydro-electric development of the Minnesota Power & Light Company which is being built by the Phoenix Utility Company of Duluth at Fond du Lac, Minn. The photograph on the cover of this issue of SUCCESSFUL METHODS gives an idea of the plant layout that is making such rapid progress possible.

The dam for this project is of the arch type, having a spillway about 600 ft. in length, and is 85 ft. high. Two main steel penstocks 18 ft. in diameter and an exciter penstock, 4 ft. in diameter, will carry the water 300 ft. through a cut 65 ft. deep to the power house, where two units of 15,500 hp. each and an exciter unit of 450 hp. will be installed. A tailrace has been excavated from the power house to the St. Louis River, a distance of 550 ft.



THIS ELECTRIC HOIST OPERATES ONE OF THE DERRICKS

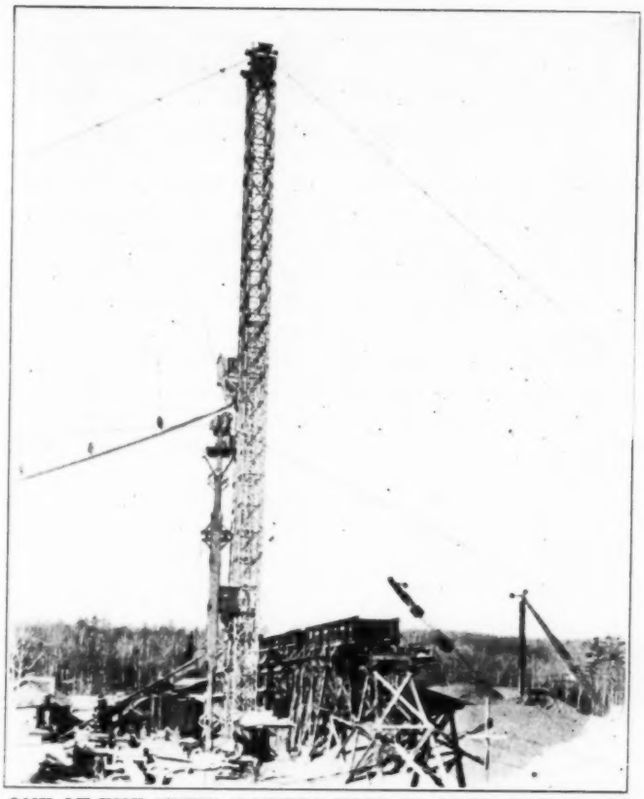
The construction camps on the west bank



A GENERAL VIEW OF THE JOB SHOWING THE DERRICKS ENGAGED IN VARIOUS CONSTRUCTION ACTIVITIES

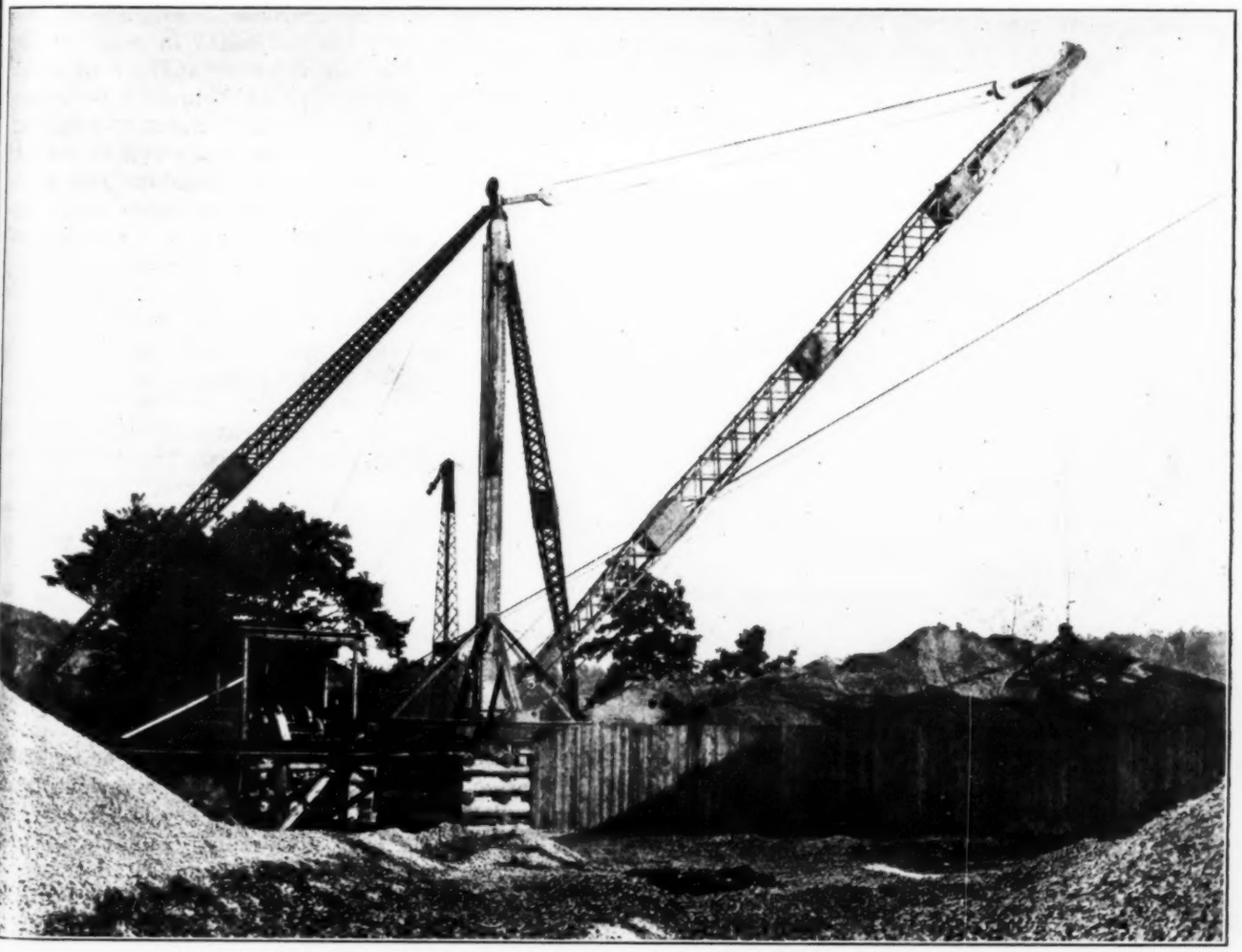
of the St. Louis River and just below the site of the dam are near completion, being steam heated, electrically lighted and with toilets and shower baths. The two mess halls with central kitchen can accommodate 450 at a single meal. There is a fully equipped first-aid hospital and a nurse always on duty.

The construction plant is on the east side of the river and has a most efficient concrete mixing layout. The sand and stone bins are built to be filled directly from standard railroad dump cars on overhead tracks, or from storage by a 10-ton capacity steel stiff-leg derrick. Two 40-ton saddle tank locomotives handle all the railroad



ONE OF THE STEEL TOWERS USED IN CONCRETE WORK

work. The sand and stone pass directly from bins into the batch hoppers of 2 1-yd. tilting mixers. These mixers are in a pit 16 ft. below the surface of the ground and are operated from the mixing platform. All cement is carried from the cars by a portable belt conveyor and two fixed conveyors into the building and directly to the mixers. The two mixers are dumped directly into bucket elevators at the bottom of two steel towers, the bottom of these towers being on the same elevation as the mixers. These towers are 240 ft. in height, and concrete can be spouted from them to any portion of the dam or power house. The concrete buckets are handled



AN 80-FT. STIFF-LEG DERRICK WHICH TAKES CARE OF THE SAND AND STONE STORAGE

by two 60-hp. electric concrete tower hoists. There has been no difficulty in mixing and placing 1275 yd. of concrete a day from this plant.

During the early part of the construction a cofferdam, 710 ft. long and averaging 20 ft. high, was placed across the river. This inclosed the river section of the dam site, which was excavated, and that part of the dam completed above high water level. This cofferdam was then removed, the upstream portion dynamited and four sluice gate openings left in the dam are now carrying the river back in its original channel.

A 7½-ton cableway with an 800-ft. span crosses the river at the dam location. This cableway has been in continuous use on cofferdam construction, placing forms, plumbs and concrete. The concrete is carried in 2-yd. bottom-dump buckets by the cableway to the forms. Four 10-ton, 95-ft. boom steel derricks, two in the bed of the river and one on each bank, have been in steady use for excavation placing plumbs and forms while a 20-ton, 115-ft. boom derrick has served the power house job in the same capacity, and an 80-ft. stiff-leg derrick has taken care of the sand and stone storage. These derricks are operated by electric and steam hoists. The bulk of the excavation for the job has been taken out by two ¾-yd. steam shovels on caterpillar traction and one ¾-yd. shovel on traction wheels together with three 7-ton gasoline locomotives and 4-yd. dump cars.

Work has progressed very favorably at the power house, 15,000 cu. yd. of earth and ledge having been excavated. All foundations are concreted to the elevation of and ready for the scroll cases of the wheels. Excavation for the tailrace was commenced the first of September and completed during the last of November, over 60,000 yd. of earth being removed. A cofferdam about 450 ft. long was built to protect this work.

TAKING RUTS OUT OF GRAVEL ROADS

AFTER months of experimentation on roads in the southern part of the State the Indiana Highway Department has devised a method for taking ruts or corrugations out of gravel roads. A. H. Hinkle, Maintenance Superintendent of the Highway Commission, deserves the credit for the new method which already has been christened the Hinkle method.

Mr. Hinkle's plan is simple. In the main it consists chiefly of crushing gravel and stone so that it will pass through a 1-in. screen and then applying the dust with the screenings. He has found that by using the dust and following its application up by systematic maintenance, ruts are almost entirely eliminated.

The plan has worked so well on the roads on which it has been tried that the Indiana Highway Department has adopted it for all gravel and stone roads. According to Mr. Hinkle, corrugations are formed in gravel roads when traffic reaches a certain density and are caused by the vibration of cars combined with the slipping or "kick back" of the drive wheel as it drops into the trough of the corrugation. It has been found that corrugation develops much faster after a rain because water is splashed out of the depressions and carries with it gravel and sand.

These corrugations develop in all types of gravel roads, but seem to develop faster in gravels lacking cementing material and which are deficient in coarser pebbles. Gravels with an excess of fine silica sand and no cementing value corrugate readily. For these reasons, Mr. Hinkle has succeeded in reducing the corrugation, as said before, by the addition of a thin coat of the crushed gravel passed through a 1-in. opening and containing all the dust incident to crushing. Crushed limestone of the same grade can be used in the same way. Roads made of limestone and maintained by the dragging process corrugate much less than the average gravel road. This is due to the fact that the limestone has a greater cementing value.

The use of a heavy drag is advocated by Mr. Hinkle to prevent the formation of corrugations. Such a drag or grader planes off the surface and does not vibrate as is the case with lighter equipment.

Mr. Hinkle also has his workers drag a road just after it is given a surface treatment of bituminous material and clean stone chips. This innovation, started last summer, took out the irregularities often to be found, and proved so successful that other States are now dragging their surface treated roads, he said.

1923 FEDERAL AID TOTALS $290,387,000

THE magnitude of the Federal Aid program in the United States is clearly indicated by statistics given out recently by Thomas H. MacDonald, Chief of the Bureau of Public Roads. These figures give the Federal Aid work under construction on Nov. 30, 1923, and as that date approximates the end of the road building season in the greater part of the United States, these statistics give a good idea of the situation as it exists at present. They show that at that time there were 14,934 miles of Federal Aid roads under construction, the total cost of these roads being $290,387,000. The following table shows the various types of roads on which Federal Aid money is being spent: Graded and drained, 3241 miles; sand-clay, 1114; gravel, 5514; waterbound macadam, 560; bituminous macadam, 1150; bituminous concrete, 273; Portland cement concrete, 2851; brick, 224, and bridges, 36.

The 1924 record will be equally remarkable.

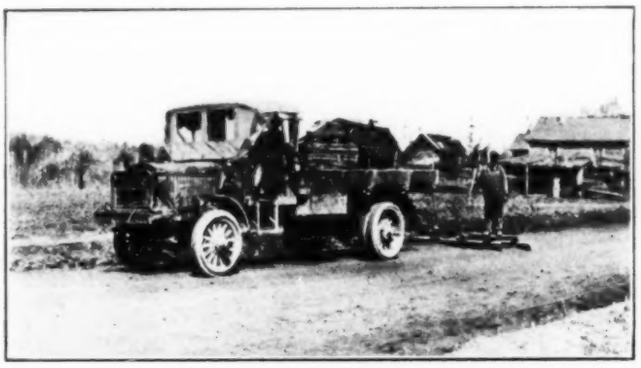
GOOD ROADS RESULT OF PROPER ORGANIZATION

Control and Coordination of Various Units of Highway Commission Are Absolutely Necessary

BY CHARLES M. UPHAM,
State Highway Engineer of North Carolina

This is the second installment of Mr. Upham's comprehensive article on the development of a highway system in a State which is spending $65,000,000 for roads.

IN locating roads the theoretical must give way to the practical. It is almost impossible to follow any set rules, but at all times the theoretical ideals may be approached. The first principle of location is based on the fact that a straight line is the shortest distance between two points. The many topographical features may, however, prevent a road from being located in a straight line and it may be that the road must be curved so as to pass around lakes, mountains or other natural features. It is also quite likely that the location of towns and cities is such that the alignment cannot follow a straight line, but the alignment must be compromised to afford road service to the different communities, giving each governing factor its proper consideration.



MAINTENANCE WORK ON STATE HIGHWAY

In the location of roads it is also quite necessary to know whether or not the road is to be a commercial or a tourist road. In cases of commercial roads it is more justifiable to spend larger sums of money for grading and alignment, whereas in the scenic roads intermediate grades and curves of shorter radius are not considered so objectionable.

The construction of State highways has probably been given more attention than any other detail at the present time. Many of the road types have divided themselves into classes, and with a careful selection of materials and proper inspection it is a simple matter to construct any of the standard pavements with almost the positive assurance that good results will follow. The problem in highway construction is not so much the method of getting good

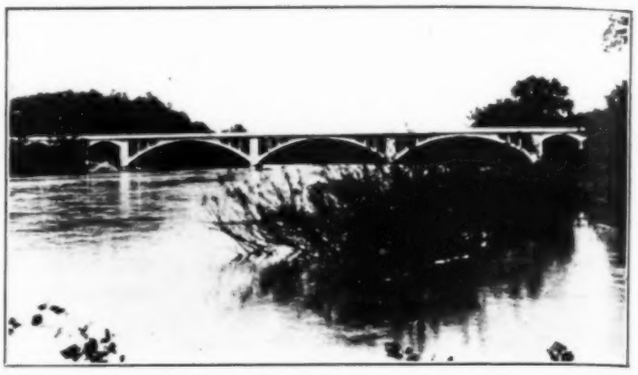
ONE OF THE MARL ROCK ROADS FREQUENTLY ENCOUNTERED IN EASTERN NORTH CAROLINA

construction, but it is the problem of controlling an organization in order to be assured of the best results. The nature of road construction is such that the representatives of the highway commission are scattered throughout the State and for long periods are not in contact with the central office. Therefore, it is absolutely necessary that the organization must be so closely coordinated and controlled that only standard methods of construction could result and a positive check on construction provided for. The problem of securing well-informed inspection and

IN SOME LOCALITIES A FERRY SUFFICES

resident engineers is a difficult one. This has been partly overcome in North Carolina by what is known as the road school, where inspectors and engineers are given a two weeks' course in the central office and most of the details of construction are briefly studied. The same methods are followed in regard to material and laboratory methods.

Probably the most difficult problem in road construction is the control of materials and the assur-



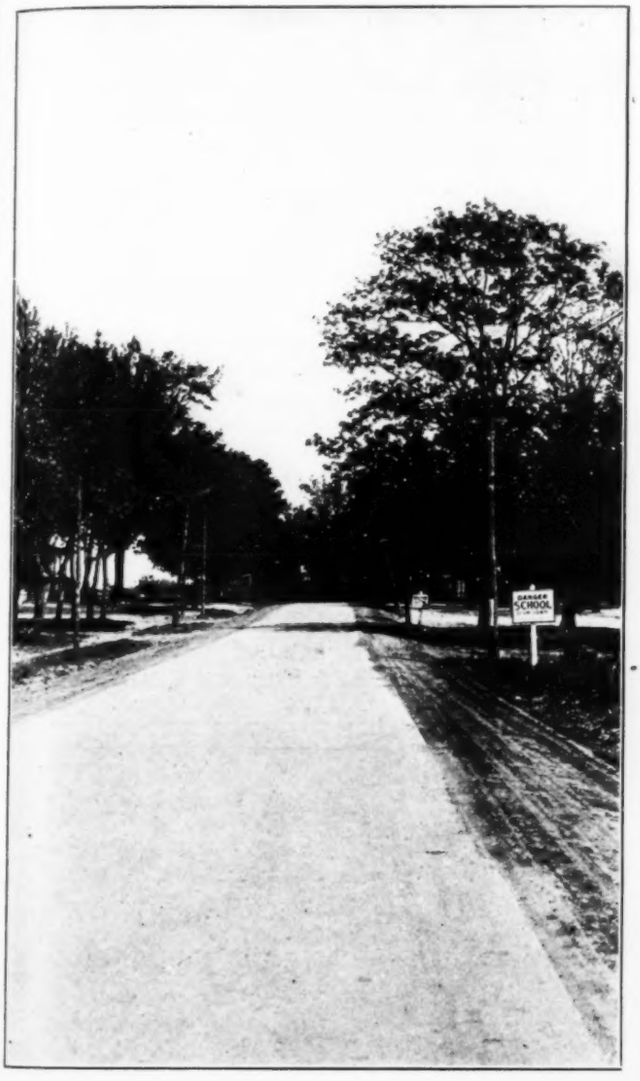
IN OTHER PLACES TRAFFIC JUSTIFIES A BRIDGE LIKE THIS

ance of procuring materials that pass the requirements of the specifications. This can only be done by the installation of an elaborate system and well-equipped laboratory where check tests may be made continuously. Perfect construction can be obtained only by eternal vigilance both in the inspection of materials and the operation in construction. The success of any organization depends on the activities of its individuals. The work of the North Carolina Commission is checked up by nine highly trained highway engineers, operating from the central office. These engineers not only check the methods of construction, but give visual inspection to the materials used in the construction.

Possibly the best road service may be rendered a road public in the economic selection of the type of road. In selecting the type of road to construct, many features should be taken into consideration. These are not only the factors of the nature of the communities influenced, but the question of the kind and

AN EXAMPLE OF THE SAND-ASPHALT ROAD WHICH CONTAINS 92 PER CENT OF LOCAL MATERIAL

character of traffic In the construction of roads where bond issues are available and large sums of money have been provided, the tendency is to construct a road, the expense of which cannot be justified. In other words, a careful estimate of the returns that a road will net should be given careful consideration before the investment is made. As an illustration, there is an instance where it is considered that a bridge may be constructed at an expenditure of $350,000. The traffic in that particular community and the future development will not justify this expenditure, for at the present time all traffic could be handled by a ferry that would not exceed the cost of $30,000. This same illustration may be applied to any number of road projects.



IN POPULOUS SECTIONS HARD-SURFACE ROADS ARE BUILT

Possibly the road that can be considered as the most important in road building and the one that gives the best road service is the one that is termed the development road. A community usually undergoes a rapid development immediately after roads are constructed. In some communities this development does not take place for several years and in others it takes place immediately after the roads are improved. Therefore, the development roads, regardless of what type is selected, must be constructed in such a manner that they may be improved to the next higher step of road construction, so that when the communities develop it is possible to better the road without losing that part of the road that is already constructed. Progressive type roads take care of this feature.

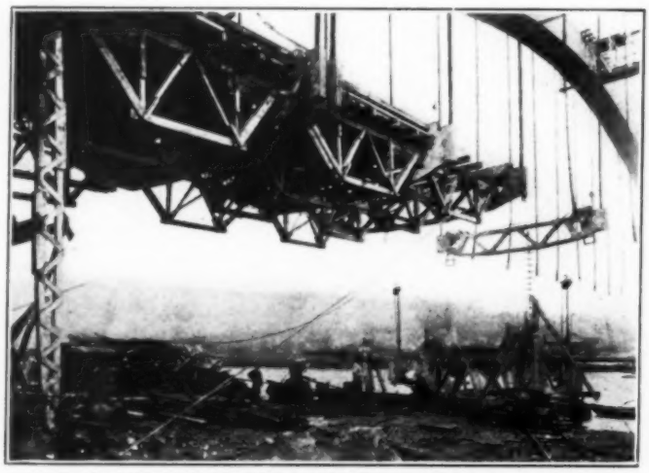
In many States development roads are being constructed largely from local materials. In North Carolina the sand asphalt roads are becoming one of the chief development roads. This road is being constructed in the communities where there is an abundance of sand. A road of this character contains approximately 92 per cent sand and 8 per cent asphalt; therefore, 92 per cent of the road is of local material. This road is being constructed single and double track at a cost of from $1.38 per square yard to $1.90 per square yard. Hard surface roads in these communities would cost from $2.80 to $4.50 per square yard. The public is receiving a road service at a comparatively low cost and is getting just what it needs for the present.

IN SPARSELY SETTLED DISTRICTS THE DIRT ROAD TAKES CARE OF TRAFFIC

LONG CONCRETE SPAN BUILT IN FRANCE

New Bridge Over Seine Measures 432 Feet Between Abutments

ONE of the largest concrete spans constructed in recent years has just been finished in France. The bridge is at St. Pierre du Vauvray, on the Seine, and replaces an old iron bridge which was damaged by a boat during a flood. When the plans for the new bridge were discussed it was decided that a clear span 432 ft. between abutments was necessary.



PLACING LATTICED CONCRETE GIRDERS WHICH SUPPORT PLATFORM OF BRIDGE

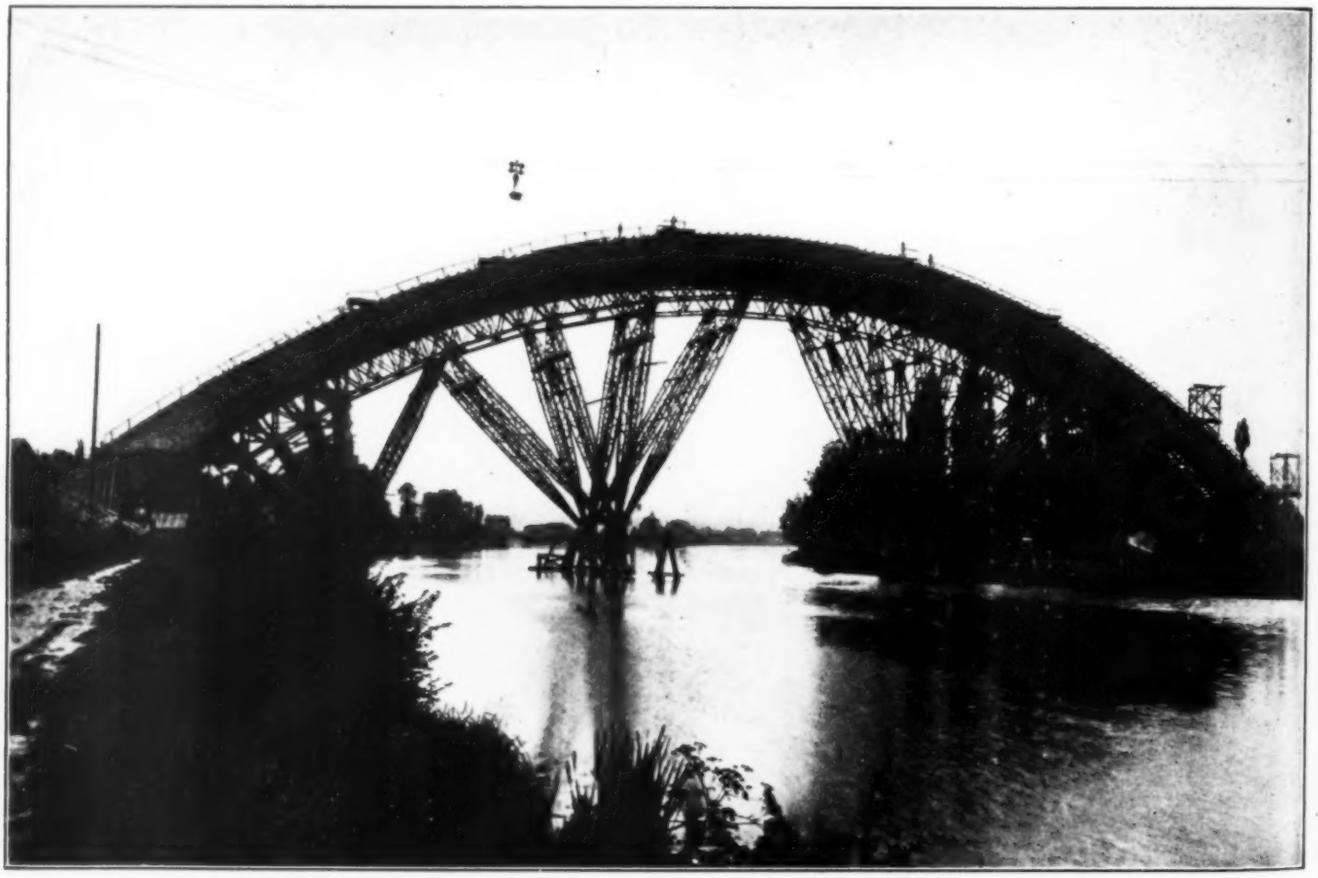
The bridge proper is composed of two reinforced concrete arches 28.9 ft. apart rectangular in cross-section with a rise of 82 ft. above the tops of the abutments. The suspended platform of the bridge is 28.9 ft. wide, carrying a roadway of 17.5 ft. and two sidewalks of 4.4 ft. each.

The platform is supported by lattice-work girders of reinforced concrete spaced 17.28 ft. apart, while the girders are suspended from the arches by means of vertical members formed of 40 steel rods ⅜ in. in diameter embedded in concrete.

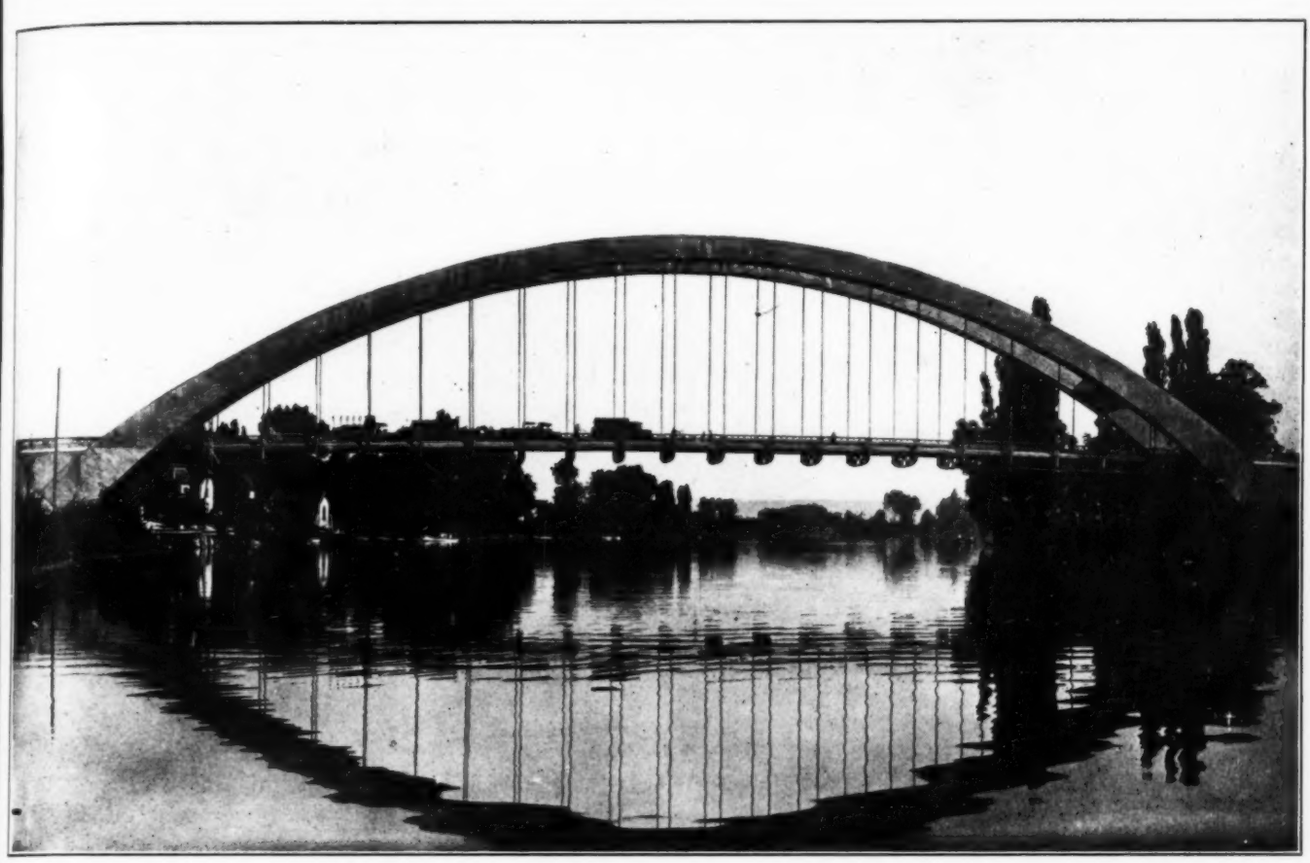
The foundations of the bridge rest on a stratum of chalk. Caissons of reinforced concrete were used and were sunk by compressed air to the desired depth and through the soft earth of the river bank. The arches rest on triangular-shaped concrete caissons which are united by an immense caisson of which the top is horizontal and located just underneath the roadway, the lower wall being perpendicular to the arch.

In constructing the bridge it was, of course, desirable that navigation be obstructed as little as possible, and the photograph at the bottom of this page shows the rather novel method used to support the forms while the concrete was being poured.

The forms, as well as the concrete used later, were handled by a cableway installed across the river. This cableway was 560 ft. long and consisted of a



A GENERAL VIEW OF THE BRIDGE DURING CONSTRUCTION SHOWING METHOD OF SUPPORT. THE CABLEWAY WHICH DELIVERED MATERIALS ALSO IS SHOWN IN THIS PHOTOGRAPH



THE COMPLETED BRIDGE WITH TRAFFIC PASSING OVER IT

double carrying cable stretched between two wooden supports guyed in place. The concrete, mixed on the ground, was placed in buckets which were elevated to one end of the cableway and run out over the forms.

The false work of the bridge was removed by a method devised by M. Freyssinet and which he had previously used in the construction of the bridge at Villeneuve-sur-Lot. Instead of lowering the false-work under the arch, the center of the arch itself was raised. For that purpose each arch was built in two independent half arches, separated at the top by a slight space. In this space were placed hydraulic jacks acting horizontally, and powerful enough to overcome the thrust of the arches when the falsework was removed. When the jacks were applied, they separated the two half arches and at the same time raised them clear of the falsework. Concrete slabs, rich in cement and strongly reinforced with steel bars, were then placed in the spaces between the jacks, which were then turned down, closing the joint, while water was kept flowing freely over the jacks to keep them clear.

Plans for the bridge were made by M. Freyssinet under the direction of M. Perrier, Chief Engineer of the Administration of Bridges and Highways, and of M. Hupner and M. Genthial, his assistants. The contract was awarded to Limousin & Co.

J. H. CRANFORD NEW HEAD OF AMERICAN ROAD BUILDERS' ASSOCIATION

J. H. CRANFORD, president of the Cranford Paving Co. of Washington, D. C., is the new president of the American Road Builders' Association. He was elected at the annual convention held at Chicago Jan. 14 to 18, and under the constitution of the Association will serve for one year. Mr. Cranford is a contractor who has been identified with the highway industry for a number of years, and is well known throughout the country. The other officers elected at the annual convention were: Vice-presidents, E. L. Powers, New York City; W. S. Keller, Montgomery, Ala.; S. F. Beatty, Chicago, Ill.; Samuel Hill, Seattle, Wash., and treasurer, James H. MacDonald, New Haven, Conn.

The 1924 Convention and Road Show set new records in every way. The attendance at both Convention and Show was greater than in any previous year. The Coliseum and adjoining buildings which housed the show were crowded every day as long as the doors were open, and those who attended displayed keen interest in the host of exhibits.

Chicago has been selected provisionally for the 1925 Convention and Show, depending on its ability to provide suitable quarters.

COLD WEATHER WORK ON POWER LINE

Pneumatic Tools Used for Small Excavations in Frozen Ground

METHODS of handling small excavations in large lots have been developed in recent years to such an extent that it is entirely practical to carry on that class of work during the coldest winters. What can be done with jobs of this kind was well demonstrated by the Pennsylvania Edison Company in the construction of two electrical power transmission lines, totaling about 80 miles in length.

The lines are carried by four-post structural steel towers, of which several hundred were required. The construction of these towers varied according to the span and the load to be carried. They ranged from 66 to 80 ft. in height and from 7200 to 14,000 lb. in weight.

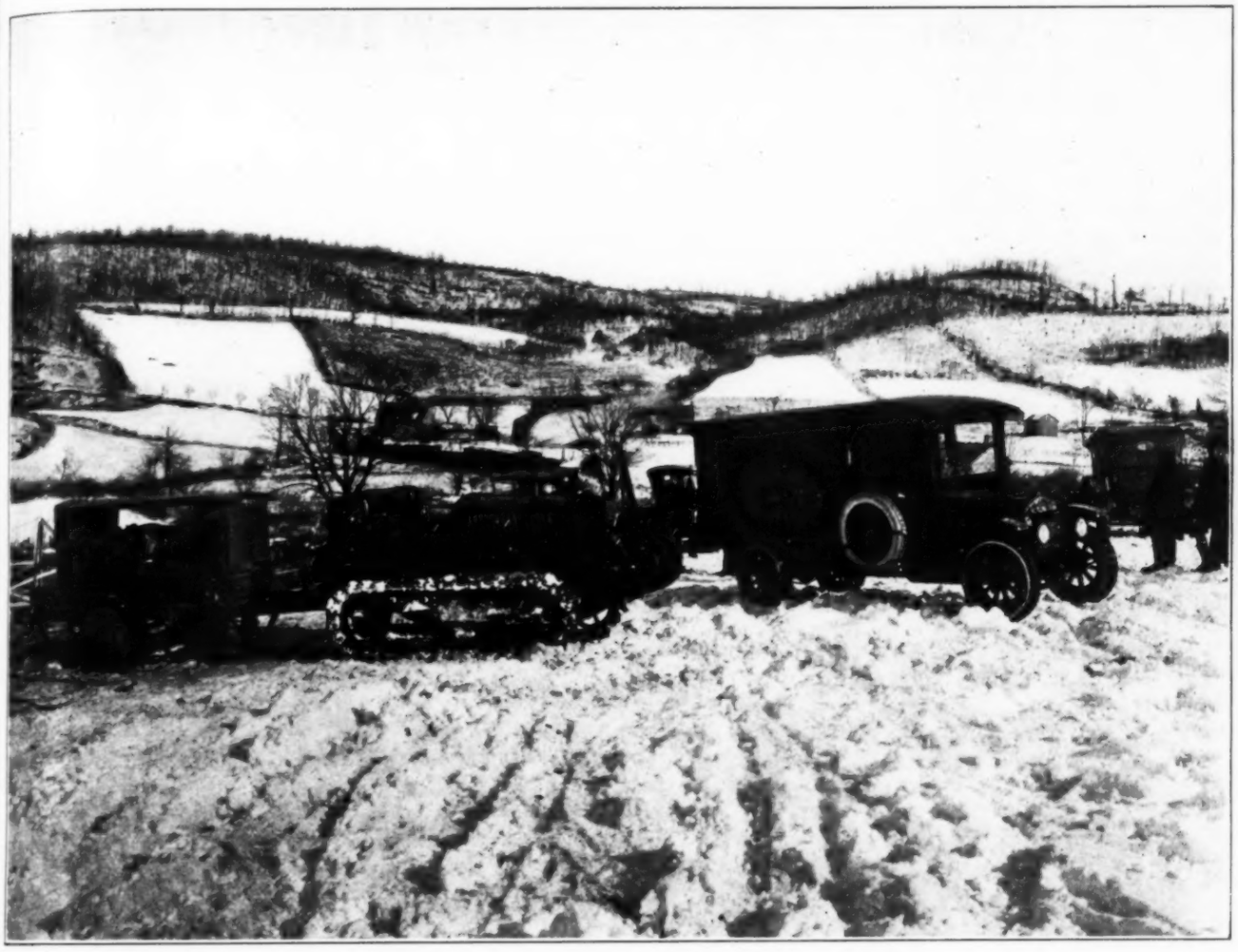
Each of the four legs of each tower was set on an anchor built up of structural shapes where soil occurred at the site of a tower. Each anchor was placed in a 6 by 6-ft. pit, 9 ft. deep. Depending on the size of the towers, the four pits for each tower were at the corners of squares measuring from 17 to 22 ft. on a side. As soon as the tower anchors were set and the feet of the posts attached to them, the pits were backfilled in layers, each layer being thoroughly tamped.

Where ledge rock was encountered, the feet of the tower posts were anchored to bolts set in holes drilled in the rock. Four 1½-in. bolts, 2 ft. long, were set as the anchorage for each post.

The decision to build the transmission lines was made at a time that required either winter work or postponement of several months until more favorable weather. As the improvement was badly needed, the work was handled right through severe winter weather. The job was also made more difficult by the fact that the transmission lines were built on direct routes across rough, hilly country and largely on private right-of-way not following highways.

Due to the conditions to be met, portable machinery was used to replace hand labor wherever possible. A portable gasoline-engine-driven air compressor furnished power for the pneumatic tools used. The compressor and engine unit were mounted on a balanced two-wheeled rubber-tired trailer. The trailer was hauled across country, up and down steep hills and frequently through deep snow, by a caterpillar tractor, as shown in one of the photographs. Many of the tower sites were inaccessible for horse-drawn wagons

LOOSENING FROZEN SPOIL PILES WITH PAVING BREAKERS



TRACTOR HAULING PORTABLE COMPRESSOR OUTFIT

or motor trucks, but were reached easily by the tractor and trailer outfit. For open road travel the trailer was hooked behind a motor truck.

Pneumatic clay diggers were used in making the excavations when the ground was not frozen. Where frozen ground occurred pneumatic paving breakers were employed. These tools easily broke up the frozen ground so it could be removed by hand. The soil below the frost line was then removed with the clay diggers.

During much of the time that the work was in progress the spoil piles from the pit excavations would freeze solid. These frozen piles were quickly and easily broken up with pneumatic paving breakers, as shown in the accompanying photograph. In this view a corner of one of the pits may be seen to the left.

The backfilling around the anchors was shoveled in by hand and then tamped with pneumatic tampers. Even when working on the frozen spoil the tampers secured a dense firm backfill. Not enough water was encountered anywhere to cause trouble.

Tough limestone had to be removed by blasting at some of the tower sites. Portable pneumatic hammers, with ⅞-in. hollow hexagon steel and four-point bits, were used to put down the necessary holes. As many as twenty holes were required at some of the sites. These holes ranged from 2 to 3 ft. in depth and were blasted with 40 per cent dynamite, 1 lb. being lightly tamped in each hole after the cartridge had been split.

After some experience, it was found that air frequently had to be furnished to seven pneumatic tools at the same time. The first compressor installed had a displacement of 118 cu. ft. per min. at the required pressure of 110 lb. This capacity was found to be inadequate, so a unit having a capacity of 210 cu. ft. was substituted with entire satisfaction.

During the early stages, drill steel was dressed in a shop at one end of the line. This necessitated moving the sharpener and drill steel back and forth between the tower sites and the base of operations. As the distance increased, the expense and delay of these moves became serious. The portable sharpener was, therefore, mounted on a motor truck with a forge and other accessories, so that the whole outfit could follow the progress of the work from tower site to tower site.

Pneumatic hoists, riveters, drills and other pneumatic tools were also used in the assembly and erection of the towers after the footings were complete. This superstructure work was done in the spring and summer, however. The two transmission lines were built by the Pennsylvania Edison Co. of Easton, Pa., under the direction of J. E. Fredericks.

WORK IS BEGUN ON MOFFAT TUNNEL

6-Mile Bore Through Continental Divide Will Open Up Vast Area for Development

TO travel east from Denver is one of the simplest things in the world. To travel west from Denver is one of the hardest things in the world, because of the mighty barrier of the Continental Divide, which also renders inaccessible anthracite and precious mineral deposits in the northwest part of the State.

That is why the Colorado Legislature passed a bill creating the Moffat Tunnel District, based on the same principles as govern city improvement districts and authorizing a $6,720,000 bond issue. That is how it happens today that men are at work on this epoch-making tunnel that is to pierce the Continental Divide and give northwestern Colorado the better transportation of which it stands so much in need.

MAIN FACTS ABOUT THE MOFFAT TUNNEL

Length, 6 miles.
Elevation of eastern portal, 9198 feet.
Elevation of western portal, 9085 feet.
Elevation of tunnel peak, 9242 feet.
Dimensions, 24 by 16 feet.
Saving in line, 23 miles.
Saving in elevation, 2406 feet.
Approximate number of workmen, 600.
Estimated time of building, 3 years.
Built by the Moffat Tunnel Commissioners for the Moffat Tunnel District.

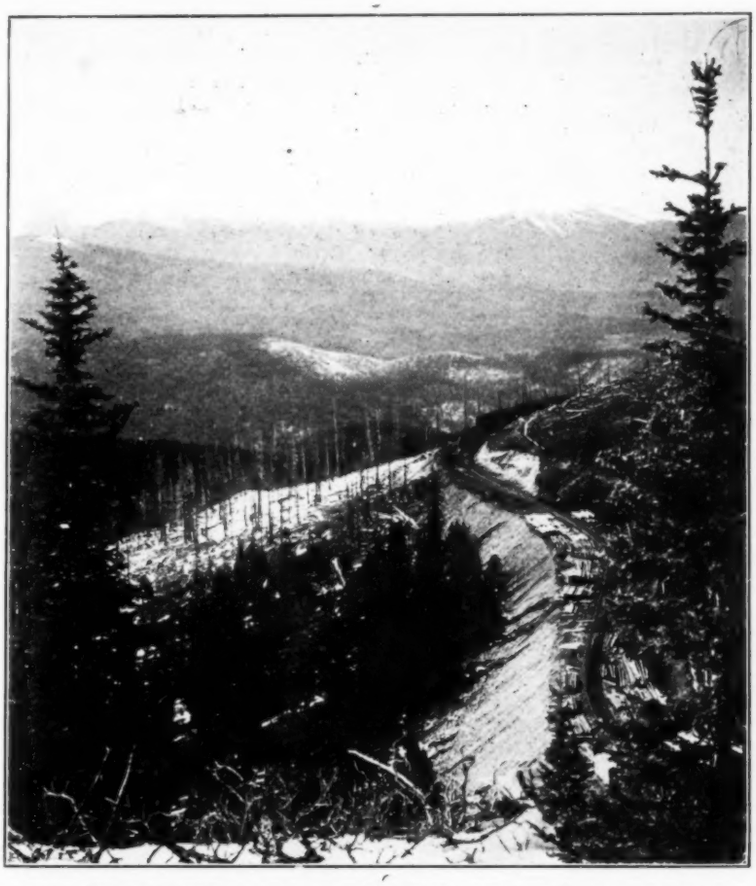
On the eastern slope the mountains are being tunneled at a point about three miles above Tolland. This eastern portal will have an elevation of 9198 ft. and therefore will be sufficiently far below timberline so that the tracks will not be blocked by the huge snow drifts of the upper levels. The western portal will be 113 ft. lower, or at an elevation of 9085 ft. The tunnel is to have a high point in the center so that it will drain more readily.

The plan is to drive the tunnel from both slopes, using a pioneer bore or water tunnel 8 by 8 ft., located at a distance of 75 ft. from the transportation tunnel. By means of cross cuts communication will be established between the two tunnels. This connection between the two tunnels will make it possible to haul

WHERE THE MOFFAT TUNNEL STARTS. THE WATER TUNNEL COVERED BY A SHED IS MORE THAN 800 FT. IN. THE RAILROAD TUNNEL OPEN CUT MAY BE SEEN AT THE LEFT

rock and muck through the water tunnel during the construction period.

The builders of this tunnel are profiting by the valuable experience of the engineers in constructing the Rogers Pass Tunnel on the Canadian Pacific Railway. This tunnel is 5.2 miles long and is at present the longest railway tunnel in North America. This tunnel, since named the Connaught, is on the main line of the Canadian Pacific and pierces the Selkirk range in British Columbia. Rogers Pass has a snowfall of from 30 to 50 ft. each winter. The cost of operating the road was so heavy that the tunnel became a necessity. A pioneer tunnel was also built in the construction of the Connaught Tunnel. The Canadian Pacific tunnel builders had softer material through which to bore, this material consisting of schist, quartzite, some clay and some talc. The material through which the Moffat Tunnel builders must bore is largely granite.



THE MOFFAT RAILROAD WHICH HANDLES TRAFFIC IN THIS VICINITY

The light air at the high altitude of the Rockies makes it necessary to compress a great volume to get sufficient air to the men who are at work. The air will probably be supplied as it was in the Rogers Pass Tunnel, through a wooden pipe. Previous tunnel-builders have tried the thin steel pipe, but the walls of this pipe do not hold up as well as a wooden wall.

The pioneer-bore method of construction that will be used was first developed in putting through the famous Simplon Tunnel, between Switzerland and Italy. It required the drilling of a small auxiliary tunnel parallel to the primary operation. Where under the usual method work on the main bore is restricted to simultaneous drilling from the two ends, the faster progress of the "pioneer bore"—due to its much smaller diameter—permits cross cuts to be run from it to the line of the main bore and double headings along the latter started from each of these.

As a single item, the pioneer bore would represent a cost of about $1,000,000. The justification of its cost is found in the use that will be made of it as a water conveyor. The city of Denver has filed on water rights near the head of the Frazer River, across the Continental Divide. A tunnel of some sort would obviously be necessary to make the supply available. Denver's new supply, as soon as carrying facilities are ready, will be at once in demand. It is estimated that the city can derive an annual income of not less than $100,000 from this source. Therefore it can afford to pay a rental for the use of the pioneer bore as a water conveyor that will pay for its construction in a short term of years.

Chief Engineer Keays estimates that the tunnel can be completed in three years, as originally planned. For this construction work approximately 600 men will be required. The present plans are to electrify the tunnel. Fires are to be banked in the steam locomotives. Electric engines will be used to haul the locomotives and trains through the tunnel. This plan will simplify the problem of ventilating the tunnel efficiently. Suction fans will be installed for this purpose. It is planned to haul automobiles through the tunnel on flat cars; this will be done at certain hours when the tunnel is free from other traffic.

Although it is probable that electric operation will at first be confined to the tunnel, yet later the electrification may be extended to include all of the line between Tolland and Tabernash.

With these facts in mind one can now turn to the Moffat Tunnel Act and view briefly its leading features:

Nine counties, either in whole or in part, comprise the Moffat Tunnel District, and the district is authorized to issue bonds for not more than $6,720,000.

This tunnel, its approaches, equipment and appurtenances shall be owned perpetually by the Moffat Tunnel Improvement District and shall remain forever a public improvement for public transportation and communication.

There shall be no monopoly for the use of this tunnel and its approaches by any person or corporation. Contracts for its use may be made until its capacity has been reached.

The contractors are Hitchcock & Tinkler, who did the work on the Hetch Hetchy project in California.

OPEN OPERATING SHIELD USED FOR WET SEWER TRENCH WORK

Steel Box Put in Place by Crane Eliminates Heavy Sheeting and Does Away with Pumping

IN constructing a sewerage system for a part of the city of Perth Amboy, N. J., the contractor, Excavating and Material Handling, Inc., used very

NIGGERHEAD ON CRANE USED IN PULLING SHIELD

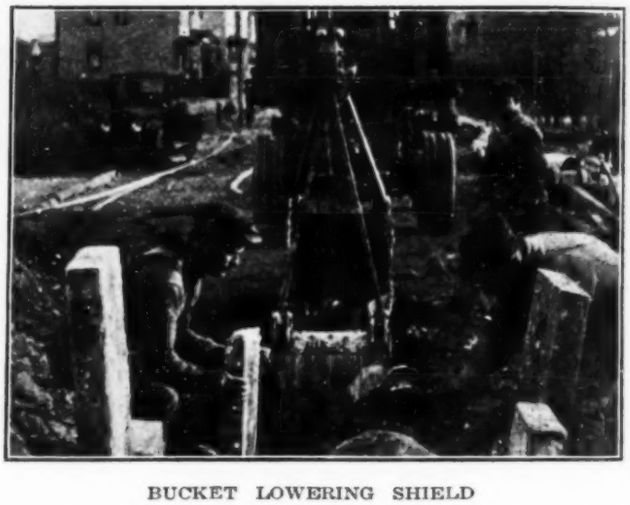
effectively an open operating shield in overcoming bad ground and water conditions. In fact, the shield and the methods of using it reduced a very serious problem to a simple operation.

Soil conditions varied considerably in different parts of the area where the job was done. In most places, however, the ground consists of stiff, tough clay, with occasional water-bearing strata above and through it. The amount of water met frequently was enough to fill the trench rapidly. The location of the water-bearing strata and the character of the material also caused the sides of the trench to cave soon after the trench was opened.

Ordinarily the situation would have been met by the use of heavy sheeting and by pumping. This sheeting would have had to be placed as fast as the trench was opened; and over much of the area that was covered, sheeting would have been driven ahead of the excavator. The shield employed did away with all sheeting and pumping. It also enabled the pipe layers to work in the dry without any risk of caving banks.

The accompanying sketch shows the general features of the shield. It consisted simply of a steel-plate box, open top and bottom and at one end. It was cross-braced midway and at the open end to prevent collapse.

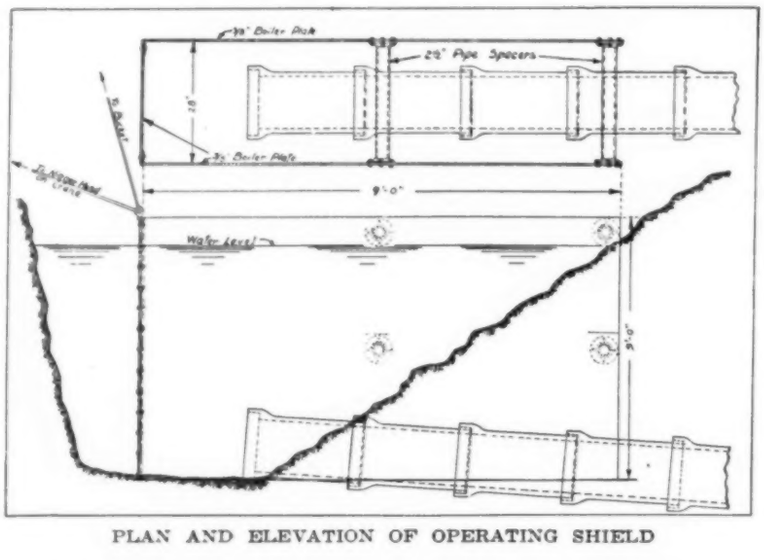
The excavation was made with a full-circle swing crane mounted on a motor truck. This crane was equipped with a 20-ft. boom and handled a ½-yd. digger type clamshell bucket fitted with special forged teeth. The crane also was equipped with a pair of nigger heads, or winding spools, one on each side of the crane base.



BUCKET LOWERING SHIELD

When working in bad ground, the bucket first opened up the trench to the required depth. The shield was then quickly set in place before a cave-in could occur. All that had to be done to secure a seal at the bottom of the shield was to force the shield down with the clamshell bucket. This was easily and quickly done. Then the inside of the shield could be kept free of water, although the water ahead of the shield at times was as deep as 4 ft.

While the pipe layers were working in the shield, the crane operator excavated ahead of it to the proper depth. Then when the pipe was laid in the shield, the latter



PLAN AND ELEVATION OF OPERATING SHIELD

was pulled along by the crane. The various operations were so timed that they kept together all the while.

In shifting the shield, it was first lifted a little at the closed end by a chain tied to the bucket on the crane boom. Now and then a pretty stiff pull was required, but the crane was always more than equal to the job. As soon as the shield was loosened, it was pulled forward into the already opened trench by a rope on one of the nigger heads. This also required a good deal of power, but as the nigger heads were driven on a 20 to 1 reduction by a 40-hp. gasoline

THE LINES ON THE SHIELD

engine, there was no trouble from that source.

In places the shield had to be held upright by planks placed between its sides and the sides of the trench. The shield was amply strong, however, to carry the pressure against it, although the banks generally caved as soon as the shield was advanced. This caving sealed the open end of the shield at the back, so that water was kept from entering there.

Working with this shield, the contractor dug from

THE CRANE WHICH DID THE EXCAVATING

90 to 140 ft. of trench per 10-hr. day, laid that amount of pipe and backfilled. The depth of trench varied from 8 to 12 ft. and the size of pipe laid from 8 to 12 in. in diameter.

During the latter part of the job the ground froze to a depth of from 8 to 14 in. By that time the contractor was working two of the full-circle swing cranes on motor trucks on this job and one on another job. He recalled the third crane and swung a 2700-lb. steel ball from the end of the boom. By raising and dropping this ball the thick, frozen crust was easily broken, although most of it was cinder or rock roadway.

The operating shield and the methods of using it were developed by O. W. Hosking of the contractor's organization, who also devised the iron ball for breaking the frozen ground. Mr. Hosking has since adapted the hard-ground breaking idea to breaking 10 to 12 in. of macadam by means of a 4000-lb. ball handled by one of his portable cranes. L. P. Booz, Jr., city engineer of Perth Amboy, cooperated with Mr. Hosking in working out these and other original methods on this job.

OLDER AND PATTERSON RESIGN

TWO men who have made enviable reputations in the highway field have recently announced their intention of giving up public office and engaging in private work.

Clifford Older, who has been connected with the Illinois State Highway Department for more than seventeen years and who has been chief engineer since 1917, has resigned. Mr. Older entered the service of the State of Illinois as bridge engineer in 1906 and while holding that position materially raised the standard of highway bridge design and construction. In the last six years as chief engineer of the department he has had charge of the great paving program which Illinois has undertaken. One of the notable features of his work has been the direction of the comprehensive series of highway research activities in connection with the Bates Test Road, which have attracted attention all over the country. After Feb. 1, or as soon as his successor has been appointed, Mr. Older will devote his time to the firm of Consoer, Older & Quinlan of Chicago. This firm, formerly the Consoer Engineering Co., of which Mr. Older has been president for some time past, has a general engineering practice, specializing in the design and construction of water supply, sewerage and drainage systems, paving and bridges and industrial developments.

Irving W. Patterson, who has been State Highway Engineer of Rhode Island for a number of years, also has announced his intention of resigning that position and going into private practice. Mr. Patterson is a highway engineer of great ability and has taken a prominent part in highway organization, not only in his own State but throughout the country.

BUILDING A RAILROAD TO THE COAL FIELDS

Elevating Graders and Fresno Outfits Aid in Construction of 30-Mile Branch Line in Montana

BY C. P. BURTON

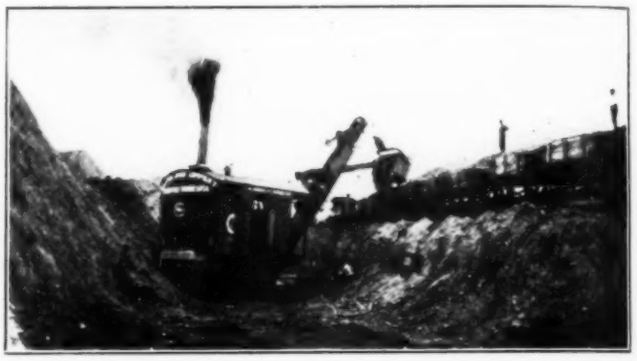
FREQUENT strikes in the coal fields are disturbing factors in railroad operation which the great carrying companies are trying to meet in various ways.

The Northern Pacific Railroad seems to have solved the problem, for a part of its system at least. This company is building a branch railroad 30 miles long from Forsyth, Montana, into the Rosebud coal fields, where a large tract of coal land has been acquired. It will have cost the railroad company $2,000,0000 before a pound of coal is mined, but the actual work of mining will be inexpensive, to cost, it is said, only a few cents a ton. The work will be done by the method known as stripping; that is, removing the cover or overburden which covers the coal deposit, then taking out the coal with steam shovels and loading it into narrow-gage side dump-cars for hauling to the tipples.

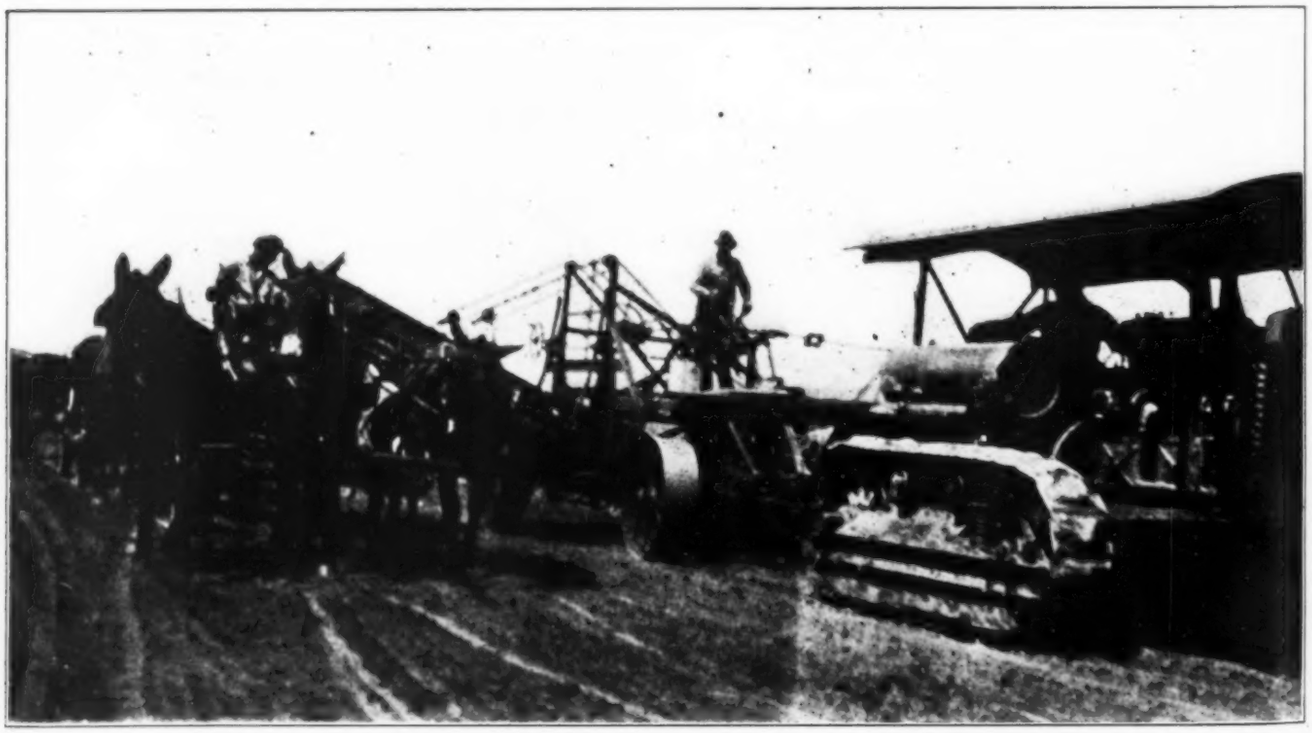
USING DUMP WAGONS IN BUILDING UP THE ROAD BED

Winston Brothers' Company of Minneapolis, Minn., received the general contract for the construction of this branch line. There are several steam shovels on the job and many elevating graders and fresno outfits, the excavation involving 1,000,000 cu. yd. of material.

Montana is said to have coal deposits amounting to 300 billion tons, in addition to other natural resources, which give it the name of the Treasure State. One authority says 400 billion tons, but what is a billion tons of coal between friends?

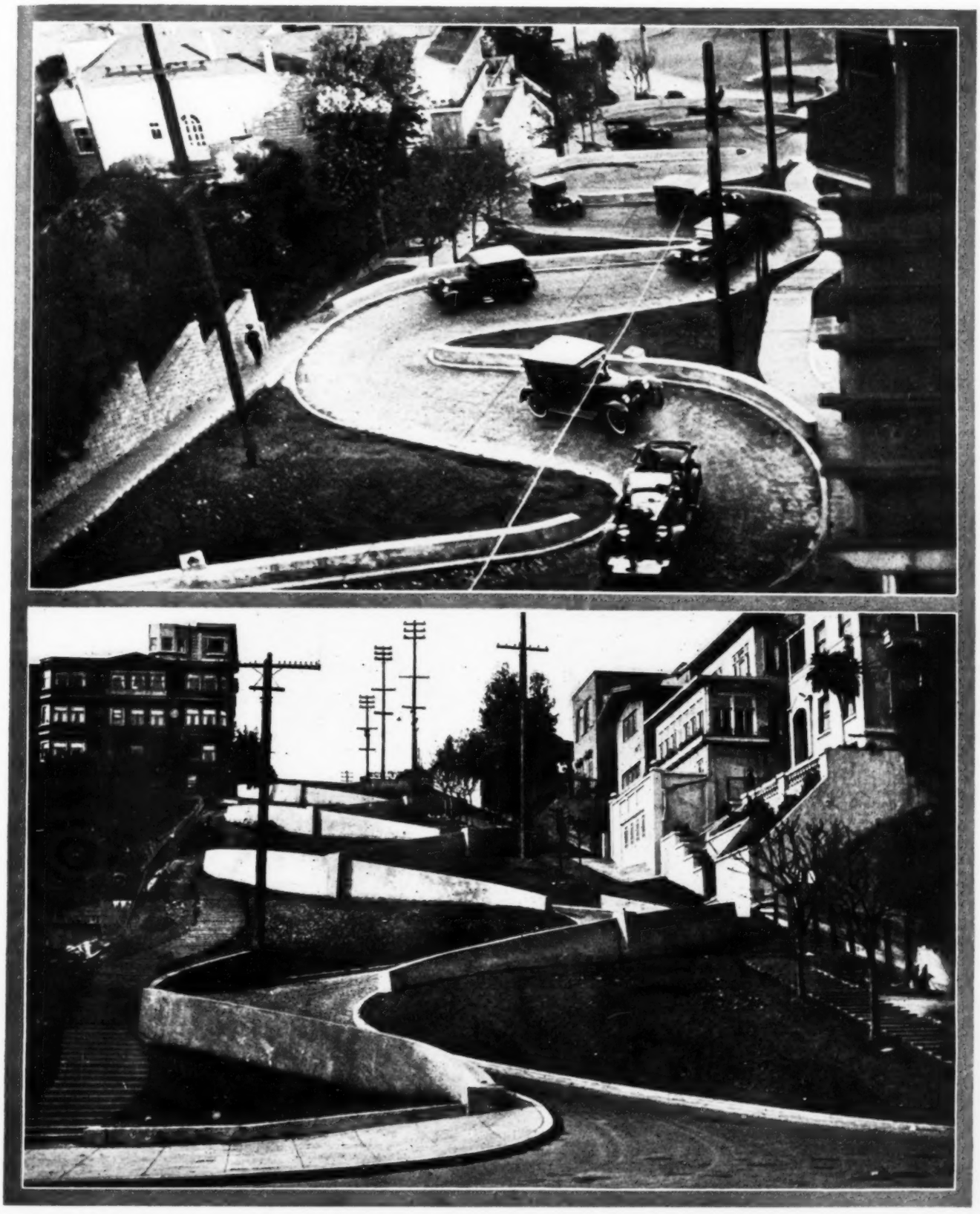


STEAM SHOVEL LOADING SIDE DUMP CARS



A 1923 MODEL ELEVATING GRADER PREPARING THE RIGHT-OF-WAY FOR THE TRACK-LAYING JOB

San Francisco's Spiral Street



The two photographs above show the San Francisco solution of a difficult street construction problem. Lombard Street used to have a 30 per cent grade. Now the grade is only 17 per cent and the street is usable. *© P & A Photos.*

FAST WORK ON VIBROLITHIC JOB

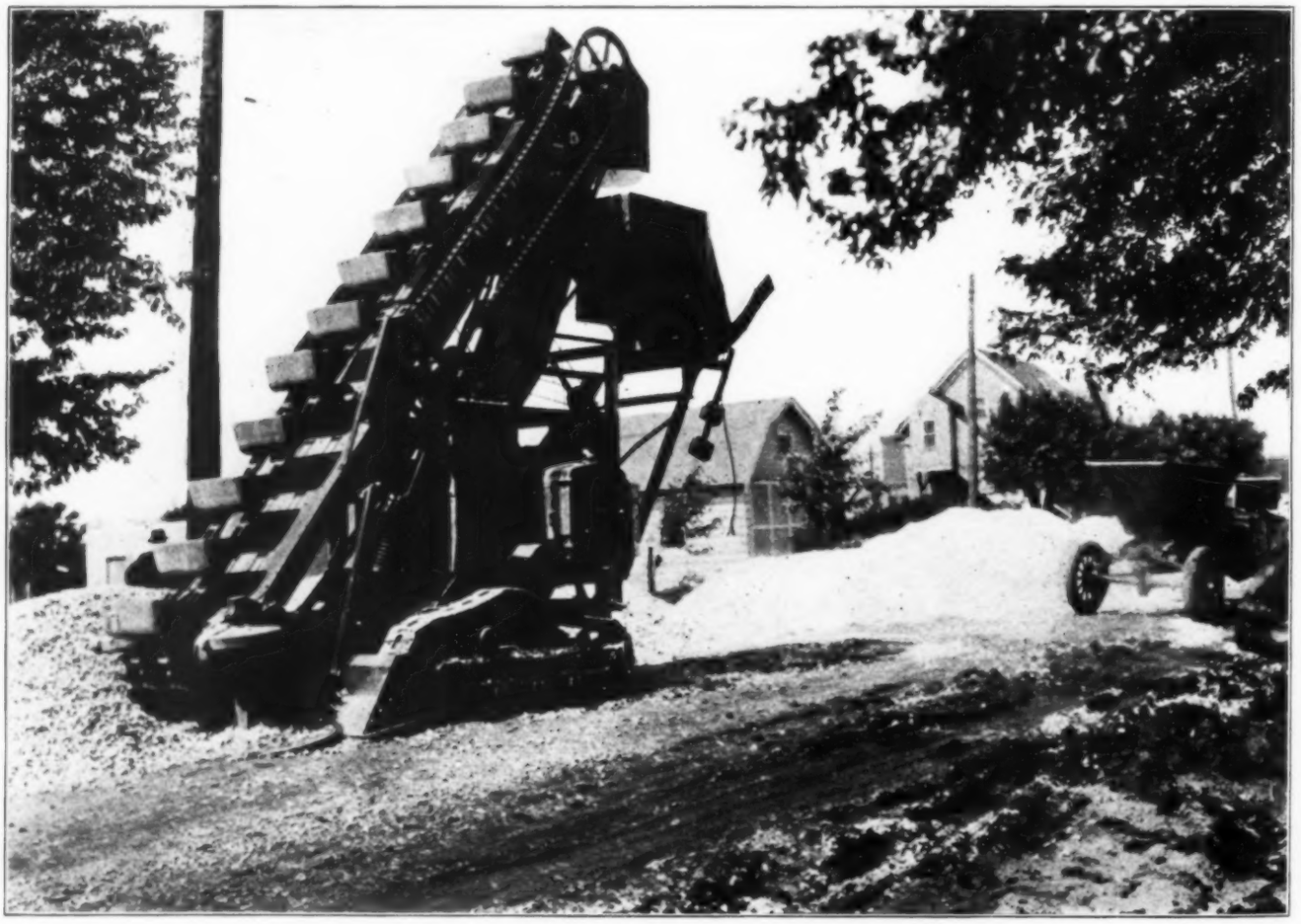
Milwaukee Contractor Uses Loader to Keep Mixer Supplied With Stone

ON a concrete job with a vibrolithic finish John Dean, a Milwaukee contractor, averaged 680 sq. yd. of pavement per 9-hr. day and on one day reached a maximum of 796 sq. yd. This pavement, which was placed on Rawson Avenue, South Milwaukee, was a little more than a mile in length and varied in width at different points. The widest point was 37 ft. and the narrowest was 19 ft. The thickness of the slab was 7 in. and a 1:2:4½ mix was used. Crushed Wisconsin granite was used for the vibrolithic finish.

WORKING A LAYER OF CRUSHED GRANITE INTO THE WET PAVEMENT

The mixer was supplied by four small trucks which hauled material from stock piles made at the intersections of cross streets with Rawson Avenue. These stock piles of sand and stone gave an average haul of about 500 ft. to the mixer. The sand was shoveled by a gang of four men, but the stone was handled by a bucket loader, which is operated by two men. The photograph at the bottom of this page shows this loader at work. It has just filled one of the trucks, which is disappearing at the right of the photograph, and is engaged in refilling its measuring hopper so that it will be ready for the next truck.

The upper photograph gives a general view of the job and shows the vibrolithic machines. One of the trucks carrying stone is just around the corner on its way to the mixer and another is just leaving the skip. A third truck is waiting ready to discharge its load into the skip.



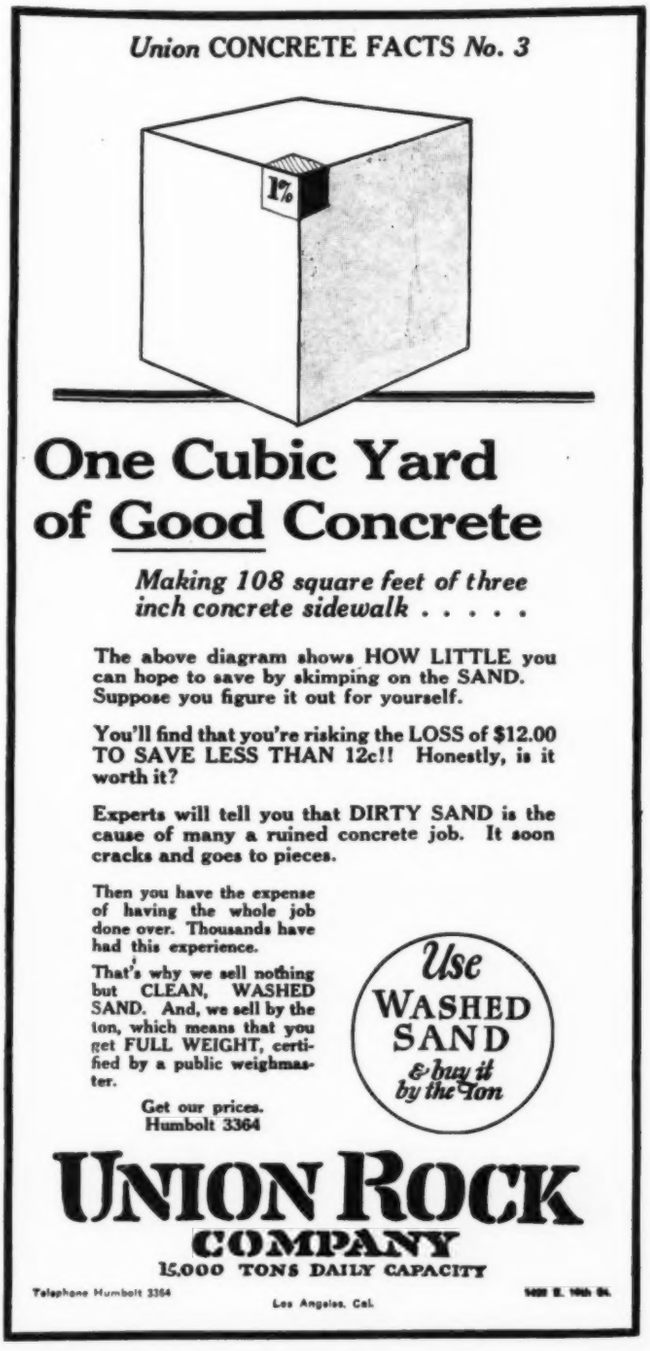
LOADER IN ACTION READY TO FILL NEXT TRUCK AS IT COMES ALONG

ADVANCING THE CONSTRUCTION INDUSTRY

Los Angeles Producers of Building Materials Take Newspaper Space to Plead for Better Concrete

FROM time to time articles have appeared in the columns of SUCCESSFUL METHODS pointing out the fact that contractors and others engaged in the construction industry do not avail themselves of their opportunities to make themselves and their work known. There is nothing that stimulates the curiosity of the public more than the sight of a new building going up, a new bridge being built or some other piece of construction work in progress. Yet the average man engaged in construction is content to see that one or two signs bearing his name are placed somewhere around the job and neglects his other chances to advertise himself and his wares.

An exception to this policy is the Union Rock Company of Los Angeles, Cal., which has gone in for newspaper advertising and has planned its campaign on a broad plane. It has put the general good of the construction industry ahead of the momentary good of the Union Rock Company, and in a series of advertisements which were printed recently in the Los Angeles newspapers has preached the doctrine of "Better Concrete." The advertisement reprinted on this page is No. 3 of the series, and by a simple illustration shows the danger of impairing the worth of the finished job by using inferior materials. The other advertisements of the series are written along similar lines, and point out the danger that besets the contractor who does not make certain that the very best of sand, gravel and cement goes into the concrete, which he in turn puts into the job upon which his reputation depends. All of these articles naturally end by stating that the Union Rock Company is a producer of clean washed sand that is suited for the finest sort of work.



The fact that a supplier of building materials is conducting an advertising campaign of this sort is a real step in advance. It shows that at least one organization devoted to construction work is wide awake to its opportunities and is seeking to acquaint the public with its ideals and aspirations. Similar opportunities to get in touch with the public exist everywhere in the country. The supplier or contractor who does not take advantage of these opportunities is false to his own interests as well as to those of the construction industry as a whole. As pointed out, the public is keenly interested in construction work, a fact which is proved by the throngs which always stop to watch a building job and which are by no means composed exclusively of idlers.

The success of future business for the contractor and the supplier lies in the public, and no stone should be left unturned to acquaint the public mind with the qualifications of the members of the great construction industry. In every city in the country contractors, suppliers and others identified with construction would do well to follow the example of the Union Rock Company and by means of well-planned advertising campaigns increase not only their own business, but make a real contribution to the whole industry.